CAPTIVE REARING OF SEA TURTLES: HEAD STARTING KEMP'S RIDLEY, *Lepidochelys kempii*

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Kemp's ridley (*Lepidochelys kempii*) is a critically endangered species.[18,30,37] It nests primarily near the village of Rancho Nuevo, Tamaulipas, Mexico, bordering the Gulf of Mexico.[29] It also nests sporadically from Veracruz, Mexico to Padre Island, Texas,[21] and recent nestings have been recorded for southwest Florida and the Carolinas. The species occurs in the Gulf of Mexico, along the eastern coast of North America to Nova Scotia, and in European Atlantic waters.[27] It also has been reported from the Azores (7), Bermuda[23] and Jamaica.[8]

Since 1977, a binational **Kemp's Ridley Recovery Program** has been directed by the **Kemp's Ridley Working Group**, composed of representatives of Mexico's Instituto Nacional de la Pesca (**INP**) and the U. S. Fish and Wildlife Service (**FWS**), National Park Service (**NPS**), Texas Parks and Wildlife Department (**TPWD**) and National Marine Fisheries Service (**NMFS**).[45] Gladys Porter Zoo, Brownsville, Texas also has participated in the program. Recently, Mexico's Instituto Nacional de Ecologia (**INE**) joined the working group.

Head starting of Kemp's ridleys is a subsidiary and experimental part of the **Kemp's Ridley Recovery Program**. It involves collecting eggs at Rancho Nuevo, Tamaulipas, Mexico, incubating them at Rancho Nuevo or Padre Island, Texas, exposing the hatchlings to either of these two beaches to "imprint" them, captive-rearing (9-11 months) and tagging the turtles in Galveston, Texas, and releasing the turtles into the Gulf of Mexico.[12,14,17,25] **INP**, with assistance from **FWS** and Gladys Porter Zoo, conducts egg collection, incubation and "imprinting" operations at Rancho Nuevo.[3] **NPS** conducted incubation and "imprinting" operations at the Padre Island National Seashore near Corpus Christi, Texas until 1988, and continues to patrol beaches at the Seashore during the nesting season in hopes of finding head started nesters.[10,31,32] The **NMFS** Southeast Fisheries Science Center's (**SEFSC**) Galveston Laboratory reared, tagged and released 22,596 Kemp's ridleys of the 1978-1992 year-classes, received as hatchlings from Padre Island and Rancho Nuevo.

All procedures, from collection of eggs through release, have been thoroughly and successfully developed.[5] However, head starting of Kemp's ridleys and other sea turtles is highly controversial.[1,2,15,22,24,26,33,35,36,39,46,47] The Recovery Plan for the Kemp's Ridley Sea Turtle (*Lepidochelys kempii*), published in 1992, calls for recovery actions needed to increase the Kemp's ridley population to a level of 10,000 females nesting during a season by the year 2020.[37] This plan emphasizes that head starting is an experiment, not a recovery action.

Tag recoveries provide the basis for determining whether or not head starting achieves ultimate success, the major criteria of which are nesting and production of viable offspring.[9,38,40] The standard method of tagging has been metal tags on the trailing edge of foreflippers, but additional external and internal tags have been used.[11,12,13,19] In mark-recapture studies of harvested marine species, most tag returns are obtained from commercial or recreational fisheries targeting those species. Because Kemp's ridley is protected from exploitation by the U.S. Endangered Species Act, uncontrolled sources were relied upon for tag recoveries. Tag recoveries of head started ridleys have been based on foreflipper tags to date, because these external tags are easily recognized and reported by fishermen and the general public. Most flipper tag returns for which a recovery method was reported were from turtles found stranded (about 50%) or caught incidentally by commercial shrimpers (about 25%). The rest were reported by other fishermen, both commercial and recreational, and the general public.

To date, no nestings of head started Kemp's ridleys have been documented. Flipper tag recoveries have shown that head started ridleys become integrated into the wild population, by growing, surviving and becoming distributed throughout the range of the species.[11,19,20] They have been found or captured among wild Kemp's ridleys in habitats typically occupied by wild Kemp's ridleys.

Published estimates of age at first maturity in wild Kemp's ridleys range from 6 to 15 yr or more.[29,48,49] Head started Kemp's ridleys reared to maturity in captivity at Cayman Turtle Farm (1983), Ltd., Grand Cayman, B.W.I., nested successfully (produced viable offspring) for the first time at age 7,[42,43,44] but Kemp's ridleys apparently grow faster in captivity than in the wild.[6] Our analysis of growth, based on the Von Bertalanffy growth curve applied to length at age data from flipper tag recoveries, suggests that head started Kemp's ridleys reach size at maturity in the wild around age 8. However, if age to maturity is 15 yr or more, no year-class of head started ridleys would be old enough to have matured until now.

Sex ratios of head started Kemp's ridleys could influence the numbers of each sex surviving to maturity. Sample sex ratios based on turtles that died during head starting included both sexes. Year-classes 1978-1984 contained an estimated 32% females.[41] Pivotal incubation temperature for Kemp's ridley eggs (i.e., that temperature which produces a 1:1 female:male sex ratio) was not known until 1985, at which time NPS began to incubate the eggs at increased temperatures. As a result, the 1985-1988 year-classes were female-dominated, containing an estimated 83% females.[31,34] Year-classes 1989-1992, incubated at Rancho Nuevo, were estimated to contain more than 90% females, so the eggs must have been incubated on that beach when temperatures were conducive to producing mostly females. Assuming that rates of mortality at sea are similar in the sexes, more females than males of the 1985-1992 year-classes would be expected to have survived, but the opposite would be expected for year-classes 1978-1984.[5]

If any head started Kemp's ridleys have matured and nested, chances are remote that anyone saw them, even though Kemp's ridleys typically nest during daytime. Direct observation of a Kemp's ridley nesting at any location other than the primary nesting beach at Rancho Nuevo probably is a rare event. Even at Rancho Nuevo, more than half of the

nests found by beach patrollers are located without observing the turtles that laid them.[28] It takes less than 1 hr for a Kemp's ridley to ascend the beach, nest and return to the water, so the window of opportunity for observing a nesting is short.[29] If seen nesting, a head started turtle still may not be recognized as such. In some cases, when head started Kemp's ridleys in the wild lost their flipper tags but retained other tags or marks, even well qualified observers failed to recognize them as head started. All Kemp's ridley nesters at Rancho Nuevo observed with flipper tag scars but no tags have been assumed to be wild. All these factors work against documentation of nestings of head started Kemp's ridleys. Use of additional tags, including the external living tag (plastron tissue transplant to a carapace scute) and the internal magnetic wire tag and passive integrated transducer (PIT) tag, should increase recognition of head started Kemp's ridleys in the wild. However, it will take a greater effort than applied in the past to examine nesting ridleys for such tags in the future.

The greatest single source of sea turtle mortality caused by humans is incidental capture by shrimp trawls,[16,18] and sea turtle strandings are correlated with shrimping.[4] Strandings and incidental capture in shrimp trawls were the two major sources of tag returns from head started Kemp's ridleys. In 1989, a **Blue Ribbon Panel** of sea turtle experts concluded it was impossible to determine whether head started Kemp's ridleys are recruited into the natural breeding pool, because shrimp trawl-induced mortality rate was so high that few if any head started ridleys were expected to reach sexual maturity.[38,40] This panel recommended the experiment be continued for 10 yr following installation of turtle excluder devices (**TEDs**) on all shrimping vessels in U.S. Gulf and Atlantic waters. In 1992, a second peer review panel[9] evaluated the experimental design of head starting, and proposed the following two hypotheses:

(1) Head starting can produce Kemp's ridley juveniles which are able to join the natural, wild population, find their way to nesting beaches and procreate (produce viable offspring); and

(2) Head started Kemp's ridleys demonstrate equivalent or superior biological fitness (equal or better survival rates from egg to reproductive adult and equivalent or better fecundity) as compared to their wild counterparts.

Currently, emphasis is being placed on testing these hypotheses, and efforts to examine nesting Kemp's ridleys for evidence they were head started have been increased. The opportunity to test head starting of Kemp's ridleys under favorable conditions of **TED** use has existed only since 1989.

LITERATURE CITED

1. Allen, C. H. 1990. Guest editorial: give 'headstarting' a chance. Marine Turtle Newsletter 51:12-16.
2. Allen, C. H. 1992. It's time to give Kemp's ridley headstarting a fair and scientific evaluation! Marine Turtle Newsletter 56:21-24.
3. Burchfield, P. M., and F. J. Foley. 1989. Standard operating procedures for collecting Kemp's ridley sea turtle eggs for the head start project, p. 67-70. In: Caillouet, C. W., Jr., and A. M. Landry, Jr. (Editors), Proceedings of the First International Symposium on Kemp's Ridley Sea Turtle Biology, Conservation and Management, Texas A&M University Sea Grant College Program, TAMU-SG-89-105, vi plus 260 p.
4. Caillouet, C. W., Jr., M. J. Duronslet, A. M. Landry, Jr., *et al.* 1991. Sea turtle strandings and shrimp fishing effort in the northwestern Gulf of Mexico, 1986-89. U.S. Fishery Bulletin 89(4):712-718.

5. Caillouet, C. W., Jr., C. T. Fontaine, T. D. Williams and E. F. Klima. In press. Accomplishments of the Kemp's ridley head start experiment. Proceedings of the Twelfth Annual Symposium on Sea Turtle Biology and Conservation, Jekyll Island, GA, 25-29 February 1992.

6. Caillouet, C. W., Jr., D. B. Koi, C. T. Fontaine, *et al.* 1986. Growth and survival of Kemp's ridley sea turtle, *Lepidochelys kempi*, in captivity. NOAA Technical Memorandum NMFS-SEFC-186, iii plus 34 p., 12 Tables, and 7 Figures.

7. Deraniyagala, P. E. P. 1939. The distribution of the Mexican loggerhead turtle *Colpochelys kempi* Garman. Bulletin de l'Institut Oceanographique (Monaco) 772:1-4.

8. Dunn, E. R. 1918. *Caretta kempi* in Jamaica. Copeia 59:75-76.

9. Eckert, S. A., D. Crouse, L. B. Crowder, *et al.* 1992. Review of the Kemp's ridley sea turtle headstart experiment. Summary Report submitted to the National Marine Fisheries Service, Southeast Fisheries Science Center, Miami, Florida, 9 p.

10. Fletcher, M. R. 1989. The National Park Service's role in the introduction of Kemp's ridley sea turtle, p. 7-9. In: Caillouet, C. W., Jr. and A. M. Landry, Jr. (Editors). Proceedings of the First International Symposium on Kemp's Ridley Sea Turtle Biology, Conservation and Management, Texas A & M University, Sea Grant College Program, TAMU-SG-89-105, vi plus 260 p.

11. Fontaine, C. T., S. A. Manzella, T. D. Williams, *et al.* 1989a. Distribution, growth and survival of head started, tagged and released Kemp's ridley sea turtles (*Lepidochelys kempi*) from year-classes 1978-1983, p. 124-144. In: Caillouet, C. W., Jr. and A. M. Landry, Jr. (Editors), Proceedings of the First International Symposium on Kemp's Ridley Sea Turtle Biology, Conservation and Management, Texas A&M University Sea Grant College Program, TAMU-SG-89-105, vi plus 260 p.

12. Fontaine, C. T., K. T. Marvin, T. D. Williams, *et al.* 1985. The husbandry of hatchling to yearling Kemp's ridley sea turtles (*Lepidochelys kempi*). NOAA Technical Memorandum NMFS-SEFC-158, iv plus 34 p., 10 Tables, 22 Figures and 2 Appendices.

13. Fontaine, C. T., T. D. Williams and C. W. Caillouet, Jr. 1988. Scutes reserved for living tags: an update. Marine Turtle Newsletter 43:8-9.

14. Fontaine, C. T., T. D. Williams, S. A. Manzella, and C. W. Caillouet, Jr. 1989b. Kemp's ridley sea turtle head start operations of the NMFS SEFC Galveston Laboratory, p. 96-110. In: Caillouet, C. W., Jr. and A. M. Landry, Jr. (Editors), Proceedings of the First International Symposium on Kemp's Ridley Sea Turtle Biology, Conservation and Management, Texas A&M University Sea Grant College Program, TAMU-SG-89-105, vi plus 260 p.

15. Frazer, N. B. 1992. Sea turtle conservation and halfway technology. Conservation Biology 6(2):179-184.

16. Henwood, T. A. and W. E. Stuntz. 1987. Analysis of sea turtle captures and mortalities during commercial shrimp trawling. Fishery Bulletin 85(4):813-817.

17. Klima, E. F. and J. P. McVey. 1982. Headstarting the Kemp's ridley turtle, *Lepidochelys kempi*, p. 481-487. In: Bjorndal, K. A. (Editor), Biology and Conservation of Sea Turtles, Proceedings of the World Conference on Sea Turtle Conservation, Smithsonian Institution Press, Washington, D.C., 583 p.

18. Magnuson, J. J., K. A. Bjorndal, W. D. DuPaul, *et al.* 1990. Decline of the sea turtles: causes and prevention. National Academy Press, Washington, D. C., 259 p.

19. Manzella, S. A., C. W. Caillouet, Jr. and C. T. Fontaine. 1988. Kemp's ridley, *Lepidochelys kempi*, sea turtle head start tag recoveries: distribution, habitat, and method of recovery. Marine Fisheries Review 50(3):24-32.

20. Manzella, S. A. and J. A. Williams. 1992. The distribution of Kemp's ridley sea turtles (*Lepidochelys kempi*) along the Texas coast: an atlas. NOAA Technical Report NMFS 110, 52 p.

21. Marquez M., R., A. Villanueva O., and P. M. Burchfield. 1989. Nesting population and production of hatchlings of Kemp's ridley sea turtle at Rancho Nuevo, Tamaulipas, Mexico, p. 16-19. In: Caillouet, C. W., Jr. and A. M. Landry, Jr. (Editors), Proceedings of the First International Symposium on Kemp's Ridley Sea Turtle Biology, Conservation and Management, Texas A&M University Sea Grant College Program, TAMU-SG-89-105, vi plus 260 p.

22. Mortimer, J. A. 1988. Management options for sea turtles: re-evaluating priorities. Florida Defenders of the Environment Bulletin 25, 4 p.

23. Mowbray, L. S. and D. K. Caldwell. 1958. First record of the ridley turtle from Bermuda, with notes on other sea turtles and the turtle fishery in the islands. Copeia 1958(2):147-148.

24. Mrosovsky, N. 1983. *Conserving Sea Turtles*. The British Herpetological Society, 176 p.

25. Owens, D. W., M. A. Grassman and J. R. Hendrickson. 1982. The imprinting hypothesis and sea turtle reproduction. Herpetologica 38(1):124-135.

26. Pritchard, P. C. H. 1980. The conservation of sea turtles: practices and problems. American Zoologist 20:609-617.

27. Pritchard, P. C. H. 1989. Evolutionary relationships, osteology, morphology and zoogeography of Kemp's ridley sea turtles, p. 157-164. In: Caillouet, C. W., Jr. and A. M. Landry, Jr. (Editors), Proceedings of the First International Symposium on Kemp's Ridley Sea Turtle Biology, Conservation and Management, Texas A & M University, Sea Grant College Program, TAMU-SG-89-105, 260 p.

28. Pritchard, P. C. H. 1990. Kemp's ridleys are rarer than we thought. Marine Turtle Newsletter 49:1-3.

29. Pritchard, P. C. H. and R. Marquez M. 1973. Kemp's ridley turtle or Atlantic ridley. International Union for the Conservation of Nature and Natural Resources, Monograph No. 2, Marine Turtle Series, 30 p.

30. Ross, J. P., S. Beavers, D. Mundell and M. Airth-Kindree. 1989. The status of Kemp's ridley. Center for Marine Conservation, Washington, D. C. 51 p.

31. Shaver, D. J. 1989. Results from eleven years of incubating Kemp's ridley sea turtle eggs at Padre Island National Seashore, p. 163-165. In: Eckert, S. A., K. L. Eckert and T. H. Richardson (Compilers), Proceedings of the Ninth Annual Workshop on Sea Turtle Conservation and Biology, NOAA Technical Memorandum NMFS-SEFC-232, 305 p.

32. Shaver, D. J. 1990. Kemp's ridley project at Padre Island enters a new phase. Park Science 10(1):12-13.

33. Shaver, D. J. and M. R. Fletcher. 1992. Kemp's ridley sea turtles. Science 257:465-466.

34. Shaver, D. J., D. W. Owens, A. H. Chaney, *et al.* 1988. Styrofoam box and beach temperatures in relation to incubation and sex ratios of Kemp's ridley sea turtles, p. 103-108. In: Schroeder, B. A. (Compiler), Proceedings of the Eighth Annual Workshop on Sea Turtle Conservation and Biology. NOAA Technical Memorandum NMFS-SEFC-214, 136 p.

35. Taubes, G. 1992. A dubious battle to save the Kemp's ridley sea turtle. Science 256:614-616.
36. Taubes, G. 1992. Kemp's ridley sea turtles: response. Science 257:466-467.
37. The Kemp's Ridley Recovery Team. 1992. Recovery Plan for the Kemp's ridley sea turtle (*Lepidochelys kempii*). Prepared for the Southwest Region, U. S. Fish and Wildlife Service, Albuquerque, New Mexico and the National Marine Fisheries Service, Washington, D.C., 40 p.
38. Wibbels, T. 1990. Panel review of Kemp's ridley headstart program. Marine Turtle Newsletter 51:26-27.
39. Wibbels, T. 1992. Kemp's ridley sea turtles. Science 257:465.
40. Wibbels, T., N. Frazer, M. Grassman, *et al.* 1989. Blue Ribbon Panel review of the National Marine Fisheries Service Kemp's Ridley Headstart Program. Report to the National Marine Fisheries Service, Southeast Regional Office, St. Petersburg, Florida, 11 p.
41. Wibbels, T. R., Y. A. Morris, D. W. Owens, *et al.* 1989. Predicted sex ratios from the international Kemp's ridley sea turtle head start research project, p. 77-81. In: Caillouet, C. W. Jr. and A. M. Landry, Jr. Editors), Proceedings of the First International Symposium on Kemp's Ridley Sea Turtle Biology, Conservation and Management, Texas A&M University Sea Grant College Program, TAMU-SG-89-105, vi plus 260 p.
42. Wood, J. R. and F. E. Wood. 1984. Captive breeding of the Kemp's ridley. Marine Turtle Newsletter 30:12.
43. Wood, J. R. and F. E. Wood. 1988. Captive reproduction of Kemp's ridley *Lepidochelys kempi*. Herpetological Journal 1:247-249.
44. Wood, J. R., and F. E. Wood. 1989. Captive rearing and breeding Kemp's ridley sea turtle at Cayman Turtle Farm (1983) Ltd., p. 237-240. In: Caillouet, C. W., Jr. and A. M. Landry, Jr. (Editors), Proceedings of the First International Symposium on Kemp's Ridley Sea Turtle Biology, Conservation and Management, Texas A&M University, Sea Grant College Program, TAMU-SG-89-105, vi plus 260 p.
45. Woody, J. B. 1989. International efforts in the conservation and management of Kemp's ridley sea turtle (*Lepidochelys kempi*), p. 1-3. In: Caillouet, C. W., Jr. and A. M. Landry, Jr. (Editors), Proceedings of the First International Symposium on Kemp's Ridley Sea Turtle Biology, Conservation and Management, Texas A & M University, Sea Grant College Program, TAMU-SG-89-105, vi plus 260 p.
46. Woody, J. B. 1990. Guest editorial: Is 'headstarting' a reasonable conservation measure? "On the surface, yes; In reality, no." Marine Turtles Newsletter 50:8-11.
47. Woody, J. B. 1991. Guest editorial: It's time to stop head-starting Kemp's ridleys. Marine Turtle Newsletter 55:7-8.
48. Zug, G. R. 1990. Estimates of age and growth in *Lepidochelys kempii* from skeletochronological data, p. 285-286. In: Richardson, T. H., J. I. Richardson and M. Donnelly (Compilers), Proceedings of the Tenth Annual Workshop on Sea Turtle Biology and Conservation, NOAA Technical Memorandum NMFS-SEFC-278, 286 p.
49. Zug, G. R. and H. J. Kalb. 1989. Skeletochronological age estimates for juvenile *Lepidochelys kempii* from Atlantic coast of North America, p. 271-273. In: Eckert, S. A., K. L. Eckert and T. H. Richardson (Compilers), Proceedings of the Ninth Annual Workshop on Sea Turtle Conservation and Biology, NOAA Technical Memorandum NMFS-SEFC-232, 305 p.